PRINCIPLES OF TRANSDUCER DEVICES AND COMPONENTS

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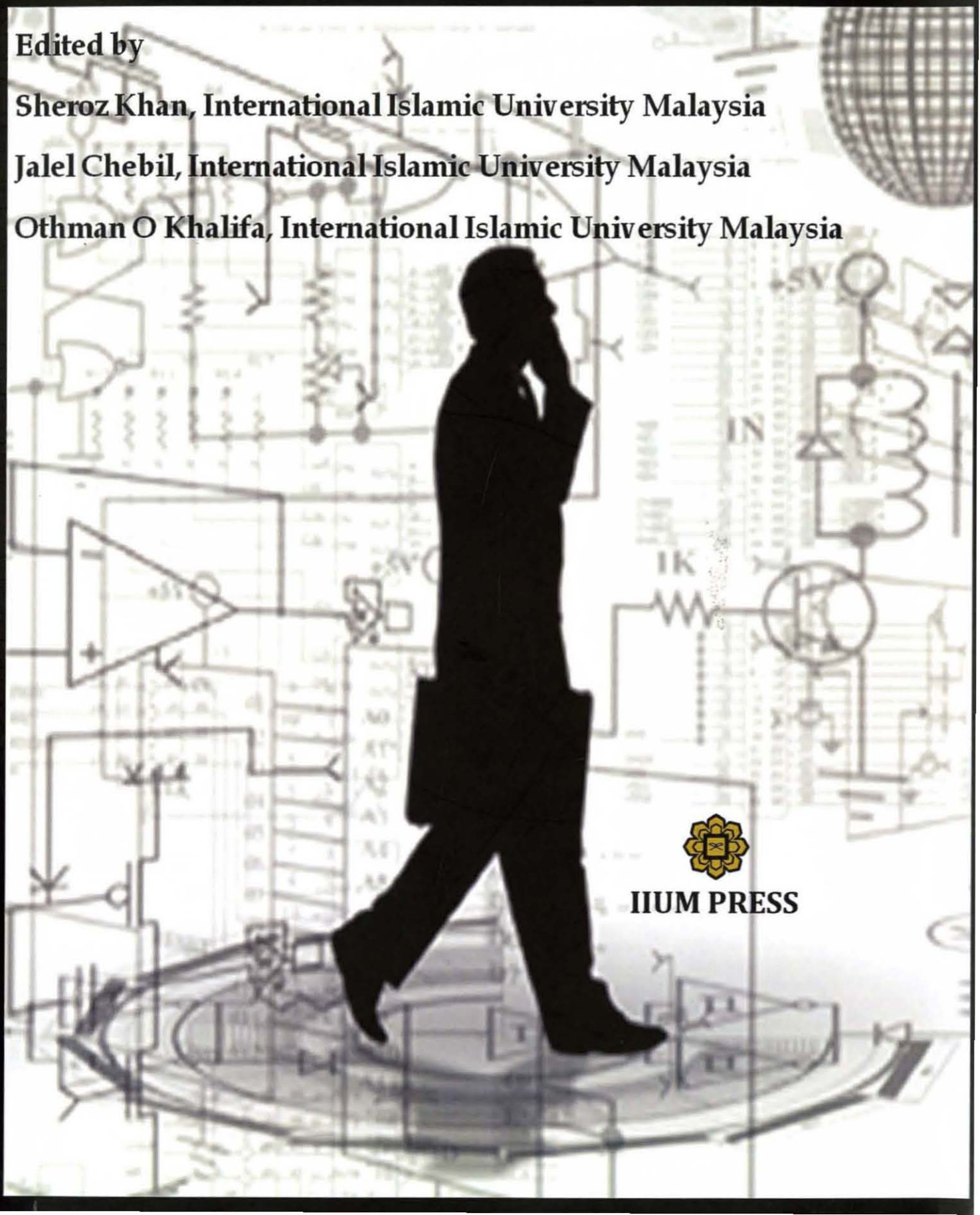

IIUM PRESS

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Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

Sheroz Khan, Jalal Chebil & Othman Khalifa: Principles of Transducer Devices and Components

ISBN: 978-967-418-172-7

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed By:
IIUM PRINTING SDN.BHD.
No. 1, Jalan Industri Batu Caves 1/3
Taman Perindustrian Batu Caves
Batu Caves Centre Point
68100 Batu Caves
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Chapter 9

ON THE ELECTRODE ARRANGEMENTS OF CAPACITIVE SENSOR FOR TWO PHASE GAS FLOW MEASUREMENT

RUMANA TASNIM, ATIKA ARSHAD, SHEROZ KHAN, MUSSE MOHAMOD

9.0 INTRODUCTION

The significance of measuring the accurate flow rate of gases in two phase flow in pipelines has been ever-increasing in the industrialized regions. There are a lot of different noncontact capacitive sensing techniques are available for measuring the mass flow rate, pressure, concentration, mean flow velocity and also some other electrical and mechanical parameters in the single, two- and multiphase flows. One of the measurement techniques for two phase flow can be carried out through determining the dielectric constant difference between two phases in flow and measuring the capacitance across the sensors. However, this kind of measurement has been found to be quite sensitive to different factors which introduce measurement errors. Recently some researchers has detected some flaws and accordingly worked on optimizing the performance of the sensors. Capacitance measurement is usually sensitive to the void fraction distribution or flow regimes because of the non-uniform electrical field inside the measuring volume. In addition the change of electrical properties of the two phases due to temperature effects on capacitive measurement. Apart from these, some other factors also contribute to the measurement errors. Different electrode arrangements have appeared to ensure increased sensitivity to permittivity changes inside the measurement pipe. Various arrangements of capacitance sensors includes flat plate, concave, ring, helical, semi ring shaped electrodes and so many. These arrangements have been widely investigated in order to attain good signal to noise ratio, achieve high sensitivity to various flow patterns, measure void fraction precisely and upgrade other design optimization factors.

9.1 RING AND CONCAVE TYPE ELECTRODE ARRANGMENT

A capacitive transducer is connected to the first one, whereas an impedance analyzer is connected to the second one; the distance between the two coils can change. On the readout coil, an equation for the impedance is derived using simple circuit analysis concepts, for showing the frequency component at which resonance is taking place. With these equations in hand, the relation of these frequencies with the system parameters is mind to be studied. This is done for obtaining simulation results that could be confirmed by experimental results. The capacitive sensor is constructed with ring and concave type